Section 1. Introduction

1.1 Purpose

This SIP describes the overall process that is to be utilized in implementing the EBnet as well as the approach and procedures to be used by the EBnet project during the integration, installation, and testing of the network.

1.2 Scope

This document covers the management, resources, processes, coordination, logistics, and schedules required to support the implementation of EBnet. Based on current requirements, all Configuration Items (CIs), both hardware and software, will be "Commercial Off The Shelf" (COTS). Accordingly, the focus of the SIP is on the activities required for a COTS implementation, such as finalization of Project planning documents, developing a system design, and generation of COTS procurement package(s), integration, testing, and culminating in a fully operational system. The SIP will also address technology insertion candidates that may come to fruition after EBnet becomes operational.

1.3 Project Overview

The network implemented by the EBnet project will provide operational communications among the ground elements of the EOSDIS, including interfaces with the International Partners participating in the EOS program. Specifically, EBnet will provide communications between the EOS Data and Operations System (EDOS) and the Distributed Active Archive Centers (DAACs), including inter DAAC communications. Operational management of the network will be accomplished from the Network Operations Center (NOC) located at Goddard Space Flight Center (GSFC). The NOC will provide operational personnel with the capability to monitor and control the network, to evaluate network performance, and to assist in maintenance activities.

1.4 References

The following documents were used or referenced in developing this SIP. Many contain additional information that will enhance the readers' understanding of the processes outlined in the SIP. To avoid duplication, information from referenced documents are not repeated herein.

a. *Earth Science Data and Information System (ESDIS) Level 2 Requirements, Volume 6, Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Requirements*, 505-10-01-6, December 1995

b. *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Status Briefing*, August 1995

c. *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document*, 540-022, March 1996

d. *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) TRMM Review Design Package*, November 1995

e. *Earth Observing System (EOS) Communications (Ecom) Security Requirements*, 540-214.1, April 1993

f. *EBnet Project Program Evaluation Review Technique (PERT) Chart*, December 11, 1995

g. *EBnet Project Contract Data Requirements List (CDRL)*, November 1995

h. *NASA Communications (Nascom) Operating Procedures (NASCOP)*, Volume 1, 542-006 V1, January 1992 and Volume 2, 542-006 V2, July 1990

c. *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) System/Acceptance Test Plan and Procedures*, 540-046, April 1996

Section 2. Overall System

2.1 System Overview

EBnet will employ internetworking technology to interconnect users via a Wide Area Network (WAN). It will use standard protocols and function at the network layer and below to provide data communications between specified NASA centers, DAACs, and other designated ground sites. The network will interface to existing NASA institutional systems and will use either satellite or terrestrial communications services.

2.2 Nodal Subsystem Configurations

Each EBnet node will consist of standards-based, state-of-the-art communications hardware, network management functionality, and common-carrier services. The configuration of each node will be determined on the basis of its projected communications traffic flow. The exact configuration will be identified in the EBnet Tropical Rainfall Measurement Mission (TRMM) and AM-1 Design Packages. The design process will identify the necessary spares and other support needed to meet EBnet operating policies and performance requirements. The actual performance characteristics will be determined in analyses and testing conducted by the EBnet Modeling, Analysis, and Testbed (EMAT) element of the EBnet project.

2.3 Configuration Items

EBnet will utilize COTS products, consistent with the EBnet project goal of minimizing total life-cycle costs for network implementation, maintenance, and operations. Product selection will be limited to that which employs selected NASA and industry *de facto* standard protocols.

The complement of CIs for EBnet will include not only the operational network elements but also those needed to support ongoing operations at each network site; on-site spares needed from installation through testing; and equipment, instrumentation, and software to support all testing to be performed from receipt of items through initial operations.

All documentation available from vendors, such as schematics, product description, maintenance, operations and other manuals, and information enabling support at the designated Line Replaceable Unit (LRU) will be specified as part of the EBnet procurement. Any training and related materials offered by vendors supplying EBnet components will be included in the overall planned training program.

2.4 Procurement of Services

The EBnet project will use procurement practices available within Nascom to implement, operate, and maintain EBnet. The Federal Telecommunications Services (FTS) 2000 procurement vehicle, managed by the General Services Administration (GSA) is the basis for Nascom procurements.

The FTS2000 contract provides Government agencies with the ability to order circuits at prenegotiated rates. However, prior to 1991 Nascom was unable to use the FTS2000 procurement vehicle since the basic FTS2000 contract specifications were not sufficient to satisfy the real-time performance requirements that Nascom must fulfill. Working jointly with the FTS2000 Network A service provider, AT&T, Nascom developed the Network Service Assurance Plan (NSAP) in 1991 to incorporate the desired performance requirements for low-rate data and voice circuits. Nascom is currently working with AT&T to develop NSAP-II, which will meet performance and customer interface requirements for high-rate circuits as well. Wherein NSAP included T1 multiplexers and Digital Access Cross Connect Switches, NSAP-II will include such customer premise equipment as IP routers, T3 multiplexers, inverse multiplexers, and ATM switches and services.

In addition to providing a vehicle for procuring communication services at a prenegotiated rate, NSAP-II will allow Nascom to procure the engineering, operations, and maintenance of those services. This approach will be applied to EBnet as well. The final negotiation and sign off of the NSAP-II contract modification is scheduled to be completed October 1, 1996. Once the NSAP-II contract is in place, Nascom will initially procure services required for EBnet under NSAP-II. By mid 1997, Nascom will begin outsourcing the Nascom network, including EBnet, to AT&T under the FTS2000 contract. All existing Nascom resources, e.g., IP routers and multiplexers, will be furnished to AT&T as GFE. Thereafter, all future requirements for EBnet will be provided to AT&T via Nascom, who will in turn analyze the existing network; determine what changes need to be made in terms of circuits, hardware, and configuration; purchase required equipment; implement, configure, and test the new equipment; and manage the resultant network.

2.5 Network Configuration

The Version (V0) prototype network developed by Code 520 and the Nascom Operational Local Area Network (NOLAN) will serve as the building blocks for EBnet. This approach was selected to capitalize on commonalties among these existing networks and EBnet in terms of technology used and the nodes supported. EBnet, within the context of EOSDIS, is depicted in Figure 2-1.

2.6 Facilities

EBnet implementation will be accomplished incrementally with specific nodes becoming available as required to support internal testing, external prelaunch integration and test activities, and ultimately, launch milestones. In order to reduce the risks associated with implementation, the GSFC node will be among the first installed and tested. EBnet will have multiple points of presence at GSFC including the NOC, the System Management Center (SMC), the EOS Operations Center (EOC), the TRMM Science Data and Information System (TSDIS), and the Flight Dynamics Facility (FDF). The Langley Research Center (LaRC) node and the Spacecraft Checkout Station and Simulator at Valley Forge, both required to support TRMM, will be the next nodes implemented, followed by sites identified to satisfy requirements on EBnet for AM-1, LANDSAT-7, and other follow-on missions. These sites include the White Sands Complex (WSC), the Landsat Processing System at the EROS Data Center (EDC), the National Snow and Ice Data Center (NSIDC), the Alaska Synthetic Aperture Radar (SAR) Facility (ASF), the Alaska and Norway Earth Stations as required, Jet Propulsion Laboratory (JPL), the National Oceanic and

Atmospheric Administration (NOAA), the Spacecraft Analysis System and Software Development System at Valley Forge, and the launch processing facility at Vandenberg Air Force Base (VAFB). In addition, two new points of presence will be included at GSFC to support Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and the Flight Software Testbed.

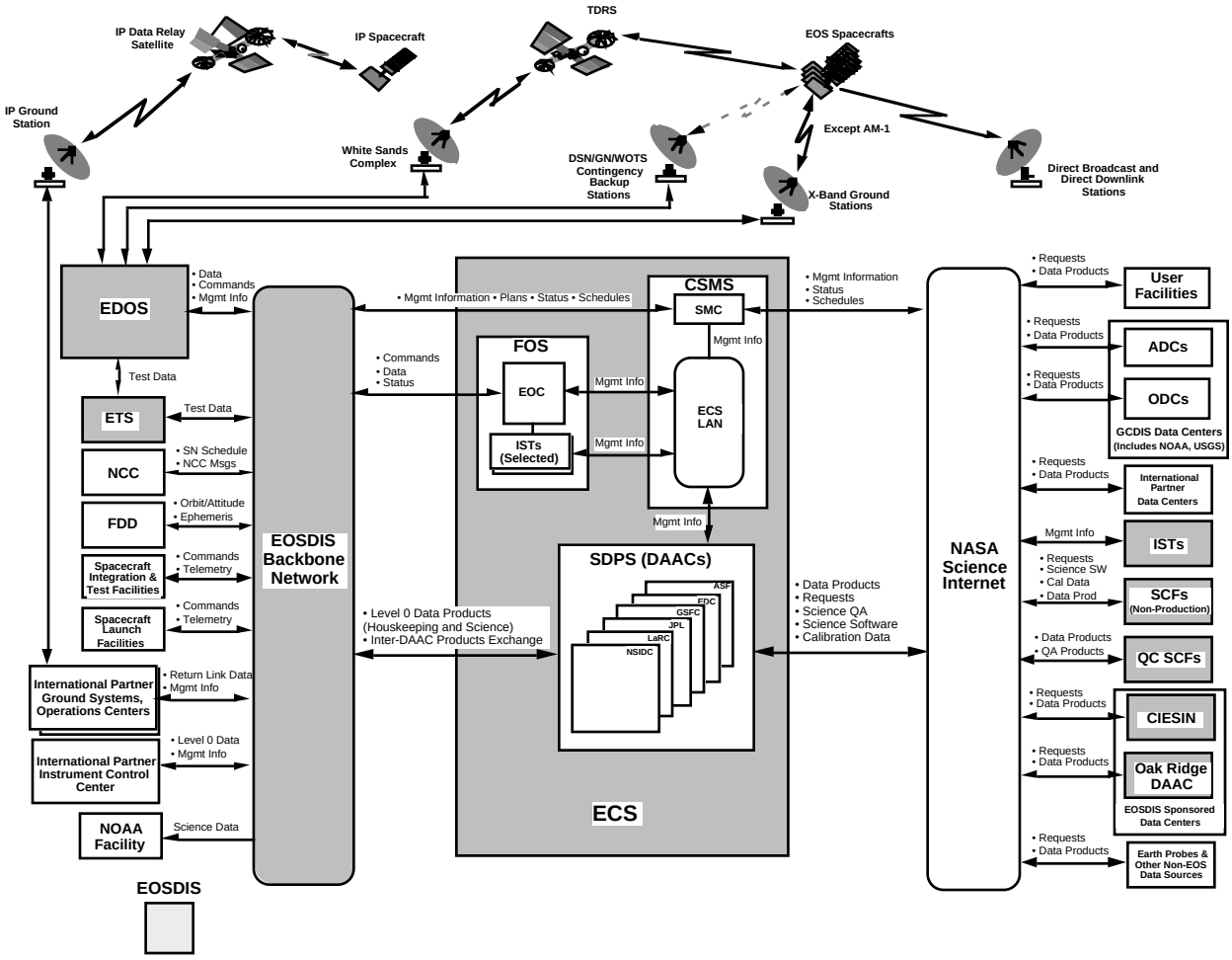

Figure 2-1. High-Level Architecture

2.7 Risks

To minimize risk, the EBnet implementation approach provides flexibility in meeting changing requirements. The system design is modular and based on COTS products, allowing for the inclusion of added capacity without redesign. The just-in-time circuit turnup strategy also allows for accommodation of network growth without redesign. Although the risks associated with this Project are low, the following implementation-specific risks are being tracked by the EBnet project:

a. Reductions in contractor support

b. Outsourcing of network

c. The integration of COTS products to perform as one viable network

d. Changing or escalating user requirements such that technology limitations are exceeded, schedule is insufficient, or design is severely impacted

e. Coupling with EOS Core System (ECS) on implementation of campus interfaces.

Each risk and associated mitigation approach is addressed below. However, an integral element in addressing all of these risks is the early identification of potential problems and the subsequent monitoring of efforts to address problems before they significantly impact ongoing EBnet activities. Implementation reporting procedures, employing such vehicles as action item lists and technical issues lists, will ensure appropriate tracking and highlighting of any problems as well as management involvement at the appropriate levels through final resolution.

2.7.1 Reductions in Contractor Support

Changes in the budget profile require reductions in contractor support for Fiscal Year '97, during the implementation phase of EBnet. NASA members of the Project team have worked with other members of the Nascom division in pursuing the necessary contract modifications to the existing GSA FTS2000 contract to enable the procurement of all EBnet services, including customer premise equipment directly off of the FTS2000 contract. This has also been incorporated as part of the overall Nascom outsourcing activity with GSA and the FTS2000 Network A carrier, AT&T, responsible for NASA networking requirements.

2.7.2 Outsourcing of Network

The in-house approach to the development of EBnet, coupled with the hands-on EMAT laboratory activity and the pursuit of existing Government-wide contract vehicles to support implementation, including direct outsourcing to a carrier, should result in the most cost-effective system possible for the Government and still meet all EOS real-time communication needs.

2.7.3 COTS Integration

Initial laboratory testing and past experience have shown that integrating several COTS products requires detailed planning. Exact COTS product configurations will be validated by EMAT through the completion of EBnet prototype activities. Personnel responsible for operating the network will be integral to finalizing the configuration. "Glue code," which is required to integrate the COTS network management software components together, will be kept to a minimum.

2.7.4 Requirements Changes

The modular design being used for build out of EBnet will allow expansion of the network capacity to accommodate some changes in user requirements without major impact. More demanding requests (those with serious cost and/or schedule impact) will be negotiated with the

Distributed Systems and Networks Office (DSNO) and end users. In addition, ESDIS has established a CCB for the collection, review, and approval of potential changes to source requirements. When ESDIS requirement changes may affect EBnet requirements or design, EBnet will provide an impact assessment via the ESDIS CCB. The EBnet project impact assessment will identify proposed requirements changes that cannot be satisfied by capabilities available from those COTS products included in the EBnet design. The potential impacts due to requirements changes that fall within this category, such as significant modifications to the EBnet design, including the introduction of custom components, will be reviewed with DSNO to address cost and schedule impacts. Where possible, these requirement changes will be negotiated directly with end users to avoid the need for significant design changes.

2.7.5 ECS Implementation

The EBnet design will be integral to the overall design of each DAAC site. The implementation of node-unique campus interfaces will be coordinated with ECS implementation activities. Technical considerations concerning campus and NASA Science Internet (NSI) interfaces are being addressed within the EBnet Design Team, which is supported by ECS engineers. The EBnet implementation at each campus will be closely coordinated with ECS release managers to allow for complete checkout of equipment and timely implementation of communications capabilities.

Section 3. Organization and Responsibilities

3.1 Functional Responsibilities

A fundamental goal of the EBnet organization structure is for Government and support contractor personnel to form a seamless team. Government personnel perform independent technical activities and/or work in teaming arrangements with contractor staff where they oversee that activity. Contractor personnel provide a range of experience and skills to augment and support their Government counterparts. The joint effort is intended to develop and strengthen the whole team and its members in the network implementation process. Figure 3-1 shows the overall organization that will support the implementation of EBnet; each function is discussed briefly below.

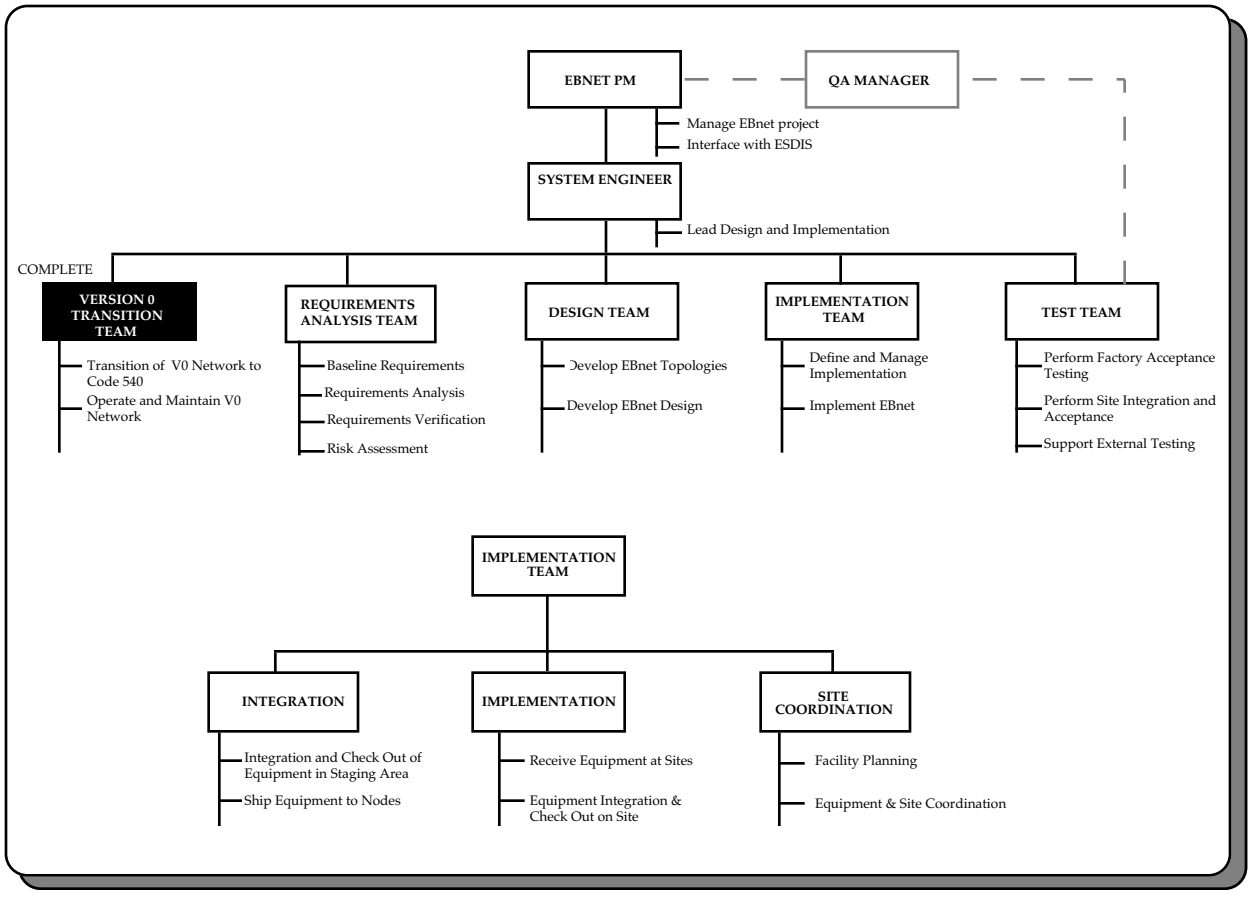

Figure 3-1. EBnet Functional Responsibilities

3.1.1 EBnet Project Manager

The EBnet Project Manager (PM) has the overall management responsibility for EBnet, including implementation. The EBnet PM will coordinate with the System Engineer to stay abreast of the current implementation status. The EBnet PM also serves as the management interface to ESDIS during the development and implementation phases.

3.1.2 System Engineer

The System Engineer (SE) leads the requirements, design, and implementation activities. The SE monitors the status of the design process and coordinates design-related activities with Project personnel. Prior to design finalization and issuance of purchase orders, the SE will approve the overall EBnet design. Consideration will be given to analysis and testing results obtained for EMAT activities.

3.1.2.1 Version 0 (V0) Transition Team

The V0 Transition Team was assigned to transition the operational V0 prototype network from Code 520 to Code 540 and is responsible for operations and maintenance of the current V0 network. A phased approach to the transition was defined and implemented by the Transition Team, working with EBnet and ESDIS management. The transition of the V0 network to Code 540 was completed in September 1995.

3.1.2.2 Requirements Analysis Team

The Requirements Analysis Team is responsible for identifying and baselining requirements, performing trace analyses and risk assessments as requirements evolve and for requirements verification.

3.1.2.3 Design Team

The EBnet Design Team is responsible for developing the overall system design, including external interfaces and network management. Once the design is finalized and approved, the Design Team will order the necessary equipment and support the Integration Team in integration and checkout of the equipment in the staging area.

3.1.2.4 Implementation Team

Several segments comprise the entire Implementation Team, including integration, implementation, and site coordination.

3.1.2.4.1 Integration

The Integration Team will receive, inspect, and test all procured items, assemble components into specific nodal subsystem configurations, and ship assembled racks to field sites. This team will be responsible for the detailed configuration and checkout of EBnet at GSFC and will ultimately become the core for the Implementation Team.

3.1.2.4.2 Implementation

Implementation Teams will conduct preinstallation site surveys, monitor and verify necessary site preparation efforts, install EBnet equipment, conduct on-site tests, augment personnel training on site, and support on-site operations at each node through an Operational Readiness Review (ORR).

3.1.2.4.3 Site Coordination

Site Coordination Teams will conduct preinstallation site surveys, monitor site preparation efforts, and conduct site-readiness inspections.

3.1.2.5 Test Team

The Test Team will plan and conduct internal system/acceptance testing and will participate in external system testing.

3.2 Organizational Responsibilities

Overall responsibility for EBnet falls under the MO&DSD, Code 500. Project oversight will be provided by DSNO. The Nascom Division has been assigned responsibility for the development, implementation, and operation of the EBnet.

3.2.1 Nascom Division

The Nascom Division delegated authority to the EBnet PM to draw upon support from the Code 540 branches and support contractors as required. Specific roles are outlined in the following sections.

3.2.1.1 Nascom System Engineering Branch

The Nascom System Engineering Branch has assigned staff to be responsible for the design, development, implementation, and testing of EBnet. Staff assigned to perform integration and checkout will be responsible for site planning, preparation, activation, and operation through ORR.

3.2.1.2 Customer Engineering Branch

The Customer Engineering Branch has assigned staff to be responsible for procurement and implementation of circuits for EBnet. The Customer Engineering Branch also serves as the primary Nascom interface to the Project offices for TRMM, Landsat-7, and AM-1. In this role Customer Engineers work with Project office staff to support planning activities and testing.

3.2.1.3 Operations Officer

The Operations Officer is responsible for Maintenance and Operations (M&O) of EBnet. Responsibilities include operations planning, assisting in the transition to operational status, and performing all M&O in the operational phase.

After successful completion of the MO&DSD ORR, the Operations Officer will assume full operational management of EBnet with the exception of the sustaining engineering activities which will continue to be managed by the Nascom Engineering Branch.

3.2.1.4 Contractor Support

Multiple contract vehicles have been exercised to optimize the skill mix among contractors. In support of the EBnet implementation, the CNMOS contractors conduct site surveys, coordinate with users, and generate Interface Control Documents (ICDs); "rack-and-stack" hardware following configuration; ship and install equipment at sites, connect to common carriers and users, and run checkout procedures on the installed equipment. The CNMOS contractor also supports design activities, defining the detailed router configurations at each node, and defining IP address assignments and subnetting configurations and ensuring proper node configurations through testing. The Hughes-STX contractor provides engineering inputs into the design process and develops the EBnet Network Management System. In support of the EBnet implementation, the Hughes-HIS Organization responsible for developing the ECS provides engineering inputs into the design process for the DAAC specific campus Local Area Networks (LANs).

Once the FTS2000 contract modification NSAP II is finalized, the design, implementation, operations, and maintenance of the network will be outsourced to the NASA FTS2000 contractor, AT&T.

3.2.2 Ground Data Systems Assurance Group

The Ground Data Systems Assurance (GDSA) Group (Code 303) provides independent assessments of system quality and conformance to NASA and GSFC requirements. The System Assurance Manager (SAM) from Code 303 assigned to the Nascom Division will provide this support to the EBnet project as well as serving as the EBnet Test Director.